

DTIC FILE COPY

④

## Special Flood Hazard Evaluation Report

AD-A212 951

# Clear Fork

Village of Pioneer  
Williams County, Ohio

Prepared for the  
Ohio Department of Natural Resources



US Army Corps  
of Engineers  
Buffalo District

DTIC  
ELECTE  
OCT 02 1989  
S E D

This document has been approved  
for public release and sale in  
distribution is unlimited.

September 1989

89 10 2 04 1

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Special Flood Hazard Evaluation Report, Clear Fork, Village of Pioneer, Williams County, Ohio		5. TYPE OF REPORT & PERIOD COVERED Final
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, Buffalo 1776 Niagara Street Buffalo, N.Y. 14207-3199		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS		12. REPORT DATE 1989
		13. NUMBER OF PAGES 16
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report)  Approved for public release; distribution unlimited		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary; and identify by block number)  Flooding Flood Control Drainage		
20. ABSTRACT (Continue on reverse side if necessary; and identify by block number)  This report presents flood hazard information for Clear Fork within the Village of Pioneer, Ohio. This report identifies the 100-year flood plain and floodway for Clear Fork. The 100-year flood plain and floodway are shown on the Flooded Area Map. The water surface profile shows the 100-year flood elevations for the study reach.		

DD FORM 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

**SPECIAL FLOOD HAZARD  
EVALUATION REPORT**

**CLEAR FORK  
VILLAGE OF PIONEER  
WILLIAMS COUNTY, OHIO**

**TABLE OF CONTENTS**

<u>Description</u>	<u>Page</u>
INTRODUCTION	1
PRINCIPAL FLOOD PROBLEMS	2
Flood Magnitudes and Their Frequencies	2
Hazards and Damages of Large Floods	2
HYDROLOGIC ANALYSES	3
HYDRAULIC ANALYSES	3
UNIFIED FLOOD PLAIN MANAGEMENT	6
Modify Susceptibility to Flood Damage and Disruption	7
a. Flood Plain Regulations	7
b. Development Zones	8
c. Formulation of Flood Plain Regulations	9
Modify Flooding	9
Modify the Impact of Flooding on Individuals and the Community	9
CONCLUSION	9
GLOSSARY	10
REFERENCES	12

**TABLES**

<u>Number</u>	<u>Title</u>	<u>Page</u>
1	Summary of 100-Year Peak Discharges	3
2	Floodway Data	5
3	Elevation Reference Marks	6

TABLE OF CONTENTS (Cont'd)

FIGURES

<u>Number</u>	<u>Title</u>	<u>Page</u>
1	Floodway Schematic	8

PLATES

<u>Number</u>	<u>Title</u>
1	100-Year Flood Profile, Clear Fork
2	Flooded Areas, Clear Fork

Accession For	
NTIS GDA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

SPECIAL FLOOD HAZARD  
EVALUATION REPORT

CLEAR FORK  
VILLAGE OF PIONEER  
WILLIAMS COUNTY, OHIO

INTRODUCTION

This Special Flood Hazard Evaluation Report documents the results of an investigation to determine the potential flood situation along Clear Fork within the village of Pioneer, Ohio. The study was conducted by the Buffalo District, Corps of Engineers at the request of the Ohio Department of Natural Resources, under the authority of Section 206 of the 1960 Flood Control Act, as amended. The area of study extends along Clear Fork from its confluence with the East Branch St. Joseph River, upstream to the western corporate limit of the village.

The village of Pioneer is in northern Williams County in northwestern Ohio, and incorporates approximately 1.6 square miles. It is surrounded by unincorporated areas of Williams County. The village is served by State Route 15 and U.S. Route 20A. The 1980 population of Pioneer was reported to be 1,133 (Reference 1).

The climate of Pioneer is continental, characterized by moderate differences in temperature and precipitation. The average annual precipitation is 31.95 inches; the average annual snowfall is 27.6 inches. The maximum recorded temperature at the nearest climatological data station was 102 degrees Fahrenheit (°F), recorded in September 1953; a minimum of -22°F was recorded in January 1973. The maximum 24-hour rainfall was 3.62 inches, recorded on April 29, 1956, and the maximum 24-hour snowfall was 14 inches, recorded on December 25, 1951 (Reference 2).

Clear Fork originates in Michigan, then flows south and east through Williams County to the East Branch St. Joseph River. The watershed is characterized by relatively low, rolling topography, with swamps as well as a pond, in the headlands. The village of Pioneer is located in the downstream part of the Clear Fork watershed, near its confluence with the East Branch St. Joseph River.

Knowledge of potential floods and flood hazards is important in land use planning. This report identifies the 100-year flood plain and floodway for Clear Fork within the village of Pioneer. The 100-year flood plain and floodway are shown on the Flooded Area Map (Plate 2). The Water Surface Profile (Plate 1) shows the 100-year flood elevations for the study reach.

The village of Pioneer is experiencing development pressure, especially in the southeast portion of the village. However, the existing Flood Insurance Rate Map (FIRM) does not have enough detail for the village to adequately manage its flood plain program (Reference 3). Information developed for this study will rectify this situation. It should also be noted that while the report does not

provide solutions to flood problems, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development.

Additional copies of this report can be obtained from the Ohio Department of Natural Resources until its supply is exhausted, and the National Technical Information Service of the U.S. Department of Commerce, Springfield, Virginia 22161, at the cost of reproducing the report. The Buffalo District, Corps of Engineers will provide technical assistance and guidance to planning agencies in the interpretation and use of the data.

#### PRINCIPAL FLOOD PROBLEMS

Clear Fork is an ungaged stream. However, long-time residents report that the stream's highest level was 875 feet in western Pioneer. Local residents also report that there has never been damage due to flooding of Clear Fork. They recall the heaviest rains to be in June of 1936, with minor flooding. However, the results of this study indicate that flooding is a problem in several areas along Clear Fork - in the area upstream of the Elm Street bridge and in the area downstream of the Lynn Street bridge. Future development should take this flood threat into consideration as unwise development in these flood plain areas would result in increased flood damages.

#### Flood Magnitudes and Their Frequencies

Floods are classified on the basis of their frequency or recurrence interval. A 100-year flood is an event with a magnitude that can be expected to be equaled or exceeded once on the average during any 100-year period. It has a 1.0 percent chance of occurring in any given year. It is important to note that, while on a long-term basis the exceedence averages out to once per 100 years, floods of this magnitude can occur in any given year or even in consecutive years and within any given time interval. For example, there is a greater than 50 percent probability that a 100-year event will occur during a 70-year lifetime. Additionally, a house which is built within the 100-year flood plain has about a one-in-four chance of being flooded in a 30-year mortgage life.

#### Hazards and Damages of Large Floods

The extent of damage caused by any flood depends on the topography of the flooded area, the depth and duration of flooding, the velocity of flow, the rate of rise in water surface elevation, and development of the flood plain. Deep water flowing at a high velocity and carrying floating debris would create conditions hazardous to persons and vehicles which attempt to cross the flood plain. Generally, water 3 or more feet deep which flows at a velocity of 3 or more feet per second could easily sweep an adult off his feet and create definite danger of injury or drowning. Rapidly rising and swiftly flowing floodwater may trap persons in homes that are ultimately destroyed or in vehicles that are ultimately submerged or floated. Since water lines can be ruptured by deposits of debris and by the force of flood waters, there is the possibility of contaminated domestic water supplies. Damaged sanitary sewer lines and flooded sewage treatment plants could result in the pollution of floodwaters and could create health hazards. Isolation of areas by floodwater could create hazards in terms of medical, fire, or law enforcement emergencies.

## HYDROLOGIC ANALYSES

Hydrologic analyses were carried out to establish the 100-year peak discharge for Clear Fork. In addition, because Clear Fork is affected by the backwater from the larger, East Branch St. Joseph River during high flows, the 100-year peak discharge was also calculated for East Branch St. Joseph River at its confluence with Clear Fork.

The Kinematic Wave Method of the Corps HEC-1 (Reference 4) was used to determine the 100-year peak discharge of Clear Fork. HEC-1 is a computerized method that has various options to simulate rainfall/runoff processes. The Kinematic Wave method was applied to determine runoff and to simulate flood routing. The drainage area of Clear Fork was divided into three sub-basins. The following input data were used for each sub-basin: (1) drainage area as determined from U.S. Geological Survey (USGS) 7.5-minute quadrangle topographic maps (Reference 5); (2) SCS curve number; (3) overland flow length; (4) representative sub-basin slope; (5) Manning's "n"; (6) channel length; (7) channel roughness; (8) channel slope; and (9) 100-year, 24-hour precipitation.

To analyze the backwater affect from the East Branch St. Joseph River, the 100-year peak discharge was calculated downstream of the Clear Fork confluence using procedures outlined in ODNR Bulletin 45 (Reference 5). Bulletin 45 provides regression equations that are used to estimate peak discharges based on watershed characteristics (e.g., drainage area, channel slope, percent ponded area, etc.).

Table 1 presents the results of the hydrologic analyses for Clear Fork and East Branch St. Joseph River.

Table 1 - Summary of 100-Year Peak Discharges

Stream	Drainage Area (square miles)	100-Year Peak Discharge (cfs)
Clear Fork	22.38	1,300
East Branch St. Joseph River	158	3,400

## HYDRAULIC ANALYSES

Analyses of the hydraulic characteristics of flooding from Clear Fork and the East Branch St. Joseph River and its confluence with Clear Fork were carried out to provide estimates of the elevations of floods of the 100-year recurrence interval.

Cross sectional data for the backwater analyses were obtained from field surveys and USGS topographic maps (Reference 5). All bridges and culverts were surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profile and the Flooded Area Map where applicable.

Water surface elevations of the 100-year recurrence interval flood along Clear Fork were computed using the Corps of Engineers HEC-2 step backwater computer program (Reference 7). The starting water surface elevation for Clear Fork was the 10-year water surface elevation of the East Branch St. Joseph River at its confluence with Clear Fork. The 10-year water surface elevation of the East Branch St. Joseph River was determined by the slope-area method at the Route 20 bridge. This bridge is located approximately 3,500 feet downstream of the confluence Clear Fork and the East Branch St. Joseph River.

Channel and overbank roughness factors (Manning's "n") used in the hydraulic analyses were based on field observations of the stream and floodplain areas and engineering judgement. For the channel, Manning's "n" ranged from 0.03 to 0.045, and for the overbank areas, the values ranged from 0.04 to 0.10. Contraction and expansion coefficients used in the analyses ranged from .2 to .4, and .4 to .6, respectively.

The computed 100-year water surface profile for Clear Fork is shown on Plate 1. The flood plain boundaries are shown on Plate 2. These boundaries were delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using USGS topographic maps and spot elevations obtained during the field surveys. Small areas within the flood plain boundaries may be above the flood elevations, but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

An encroachment floodway was also determined for Clear Fork based on equal conveyance reduction from each side of the flood plain. At the request of the Ohio Department of Natural Resources, the maximum increase in stage was limited to 1 foot, provided that hazardous velocities were not produced. Floodway widths were computed at cross sections; between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections and are shown in Table 2, Floodway Data. The computed floodway is also shown on the Flooded Area Map, Plate 2. In cases where the floodway and the 100-year flood plain boundary are either close together or collinear, only the floodway is shown.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations presented in this study are considered valid only if hydraulic structures remain clear, operate properly, and do not fail.

All elevations are referenced to the National Geodetic Vertical Datum (NGVD) of 1929. Elevation reference marks used in this study are shown on Plate 2; the descriptions of the marks are presented in Table 3 - Elevation Reference Marks.



FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE <sup>1</sup>	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY	INCREASE
A	550	230	797	1.6	869.9 <sup>2</sup>	869.1	869.2	0.1
B	2,815	218	888	1.5	871.0	871.0	872.0	1.0
C	4,835	39	265	4.9	874.5	874.5	875.0	0.5
D	5,890	50	293	4.4	876.7	876.7	877.2	0.5
E	6,435	55	368	3.5	877.4	877.4	877.8	0.4
F	8,000	100	506	2.6	878.5	878.5	879.4	0.9

(1) Distance measured from confluence with East Branch St. Joseph River.

(2) Includes backwater effect from East Branch St. Joseph River.

TABLE 2

VILLAGE OF PIONEER  
WILLIAMS COUNTY, OHIO

FLOODWAY DATA

CLEAR FORK

Table 3 - Elevation Reference Marks

Reference Mark	Elevation (feet NGVD)	Description of Location
RM 1	884.36	Chiseled "X" in west bonnet bolt of hydrant located on the southeast corner of the intersection of First Street and N. Third Street.
RM 2	878.59	Chiseled "L" to form a square on the southwest corner of the southwest abutment of the N. Elm Street bridge over Clear Fork.
RM 3	890.51	Chiseled "X" in west bonnet bolt of hydrant located on the north side of Baubice Street at Norris Street. Hydrant is located in front of residence # 209.
RM 4	874.59	Existing railroad spike in Contel power pole #35, located on the first pole west of the E. Lynn Street bridge over Clear Fork. The spike is approximately 1.0 foot above the ground.
RM 5	874.60	Chiseled "X" in west bonnet bolt of hydrant located at end of Tanglewood Lane. Hydrant is at east end of cul-de-sac.
RM 6	874.26	Existing railroad spike in power pole # 1001 located at northeast corner of intersection of Lake Shore Drive and T&W Parkway. The spike is approximately 1.0 foot above the ground.

## UNIFIED FLOOD PLAIN MANAGEMENT

Historically, the alleviation of flood damage has been accomplished almost exclusively by the construction of protective works such as reservoirs, channel improvements, and floodwalls and levees. However, in spite of the billions of dollars that have already been spent for construction of well-designed and efficient flood control works, annual flood damages continue to increase because the number of persons and structures occupying floodprone lands is increasing faster than protective works can be provided.

Recognition of this trend has forced a reassessment of the flood control concept and resulted in the broadened concept of unified flood plain management programs. Legislative and administrative policies frequently cite two approaches: structural and nonstructural, for adjusting to the flood hazard. In this context, "structural" is usually intended to mean adjustments that modify the behavior of floodwaters through the use of measures such as dams and channel work. "Nonstructural" is usually intended to include all other adjustments in the way society acts when occupying or modifying a flood plain (e.g., regulations, floodproofing, insurance, etc.). Both structural and

nonstructural tools are used for achieving desired future flood plain conditions. There are three basic strategies which may be applied individually or in combination: (1) modifying the susceptibility to flood damage and disruption, (2) modifying the floods themselves, and (3) modifying (reducing) the adverse impacts of floods on the individual and the community.

#### Modify Susceptibility to Flood Damage and Disruption

The strategy to modify susceptibility to flood damage and disruption consists of actions to avoid dangerous, economically undesirable, or unwise use of the flood plain. Responsibility for implementing such actions rests largely with the non-Federal sector and primarily at the local level of Government.

These actions include restrictions in the mode and the time of occupancy; in the ways and means of access; in the pattern, density, and elevation of structures and in the character of their materials (structural strength, absorptiveness, solubility, corrodibility); in the shape and type of buildings and in their contents; and in the appurtenant facilities and landscaping of the grounds. The strategy may also necessitate changes in the interdependencies between flood plains and surrounding areas not subject to flooding, especially interdependencies regarding utilities and commerce. Implementing mechanisms for these actions include land use regulations, development and redevelopment policies, floodproofing, disaster preparedness and response plans, and flood forecasting and warning systems. Different tools may be more suitable for developed or underdeveloped flood plains or to urban or rural areas. The information contained in this report is particularly useful for the preparation of flood plain regulations.

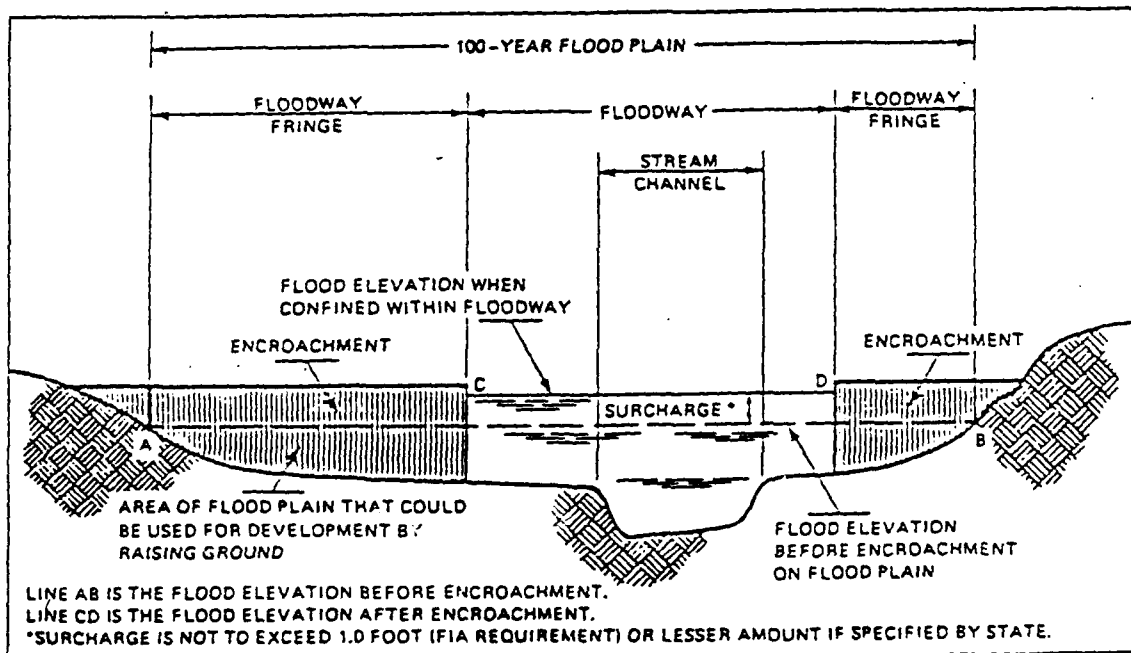
##### a. Flood Plain Regulations.

Flood plain regulations apply to the full range of ordinances and other means designed to control land use and construction within floodprone areas. The term encompasses zoning ordinances, subdivision regulations, building and housing codes, encroachment line statutes, open area regulations, and other similar methods of management which affect the use and development of floodprone areas.

Flood plain land use management does not prohibit use of floodprone areas; to the contrary, flood plain land use management seeks the best use of flood plain lands. The flooded area map and the water surface profile contained in this report can be used to guide development in the flood plain. The elevations shown on the profile should be used to determine flood heights because they are more accurate than the outlines of flooded areas. It is recommended that development in areas susceptible to frequent flooding adhere to the principles expressed in Executive Order 11988 - Flood Plain Management, whose objective is to "...avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains ... wherever there is a practicable alternative." Accordingly, development in areas susceptible to frequent flooding should consist of construction which has a low damage potential such as parking areas and golf courses. High value construction such as buildings should be located outside the flood plain to the

b. Development Zones.

The second zone of the flood plain is termed the "floodway fringe" or restrictive zone, in which inundation might occur but where depths and velocities are generally low. Although not recommended if practicable alternatives exist, such areas can be developed provided structures are placed high enough or floodproofed to be reasonably free from flood damage during the 100-year flood. Typical relationships between the floodway and floodway fringe are shown in Figure 1. The floodway for Clear Fork has been plotted on the Flooded Area Map, Plate 2.



8

### c. Formulation of Flood Plain Regulations

Formulation of flood plain regulations in a simplified sense involves selecting the type and degree of control to be exercised for each specific flood plain. In principle, the form of the regulations is not as important as a maintained adequacy of control. The degree of control normally varies with the flood hazard as measured by depth of inundation, velocity of flow, frequency of flooding, and the need for available land. Considerable planning and research is required for the proper formulation of flood plain regulations. Where formulation of flood plain regulations is envisioned to require a lengthy period of time during which development is likely to occur, temporary regulations should be adopted to be amended later as necessary.

#### Modify Flooding

The traditional strategy of modifying floods through the construction of dams, dikes, levees and floodwalls, channel alterations, high flow diversions and spillways, and land treatment measures has repeatedly demonstrated its effectiveness for protecting property and saving lives, and it will continue to be a strategy of flood plain management. However, in the future, reliance solely upon a flood modification strategy is neither possible nor desirable. Although the large capital investment required by flood modifying tools has been provided largely by the Federal Government, sufficient funds from Federal sources have not been and are not likely to be available to meet all situations for which flood modifying measures would be both effective and economically feasible. Another consideration is that the cost of maintaining and operating flood control structures falls upon local governments.

Flood modifications acting alone leave a residual flood loss potential and can encourage an unwarranted sense of security leading to inappropriate use of lands in the areas that are directly protected or in adjacent areas. For this reason, measures to modify possible floods should usually be accompanied by measures to modify the susceptibility to flood damage, particularly by land use regulations.

#### Modify the Impact of Flooding on Individuals and the Community

A third strategy for mitigating flood losses consists of actions designed to assist individuals and communities in their preparatory, survival, and recovery responses to floods. Tools include information dissemination and education, arrangements for spreading the costs of the loss over time, purposeful transfer of some of the individual's loss to the community by reducing taxes in floodprone areas, and the purchase of Federally subsidized flood insurance.

The distinction between a reasonable and unreasonable transfer of costs from the individual to the community can also be regulated and is a key to effective flood plain management.

### CONCLUSION

This report presents flood hazard information for Clear Fork within the village of Pioneer, Ohio. The U.S. Army Corps of Engineers, Buffalo District, will provide interpretation of the application of the data contained in this report, particularly as to its use in developing effective flood plain regulations. Requests should be coordinated with the Ohio Department of Natural Resources.

## GLOSSARY

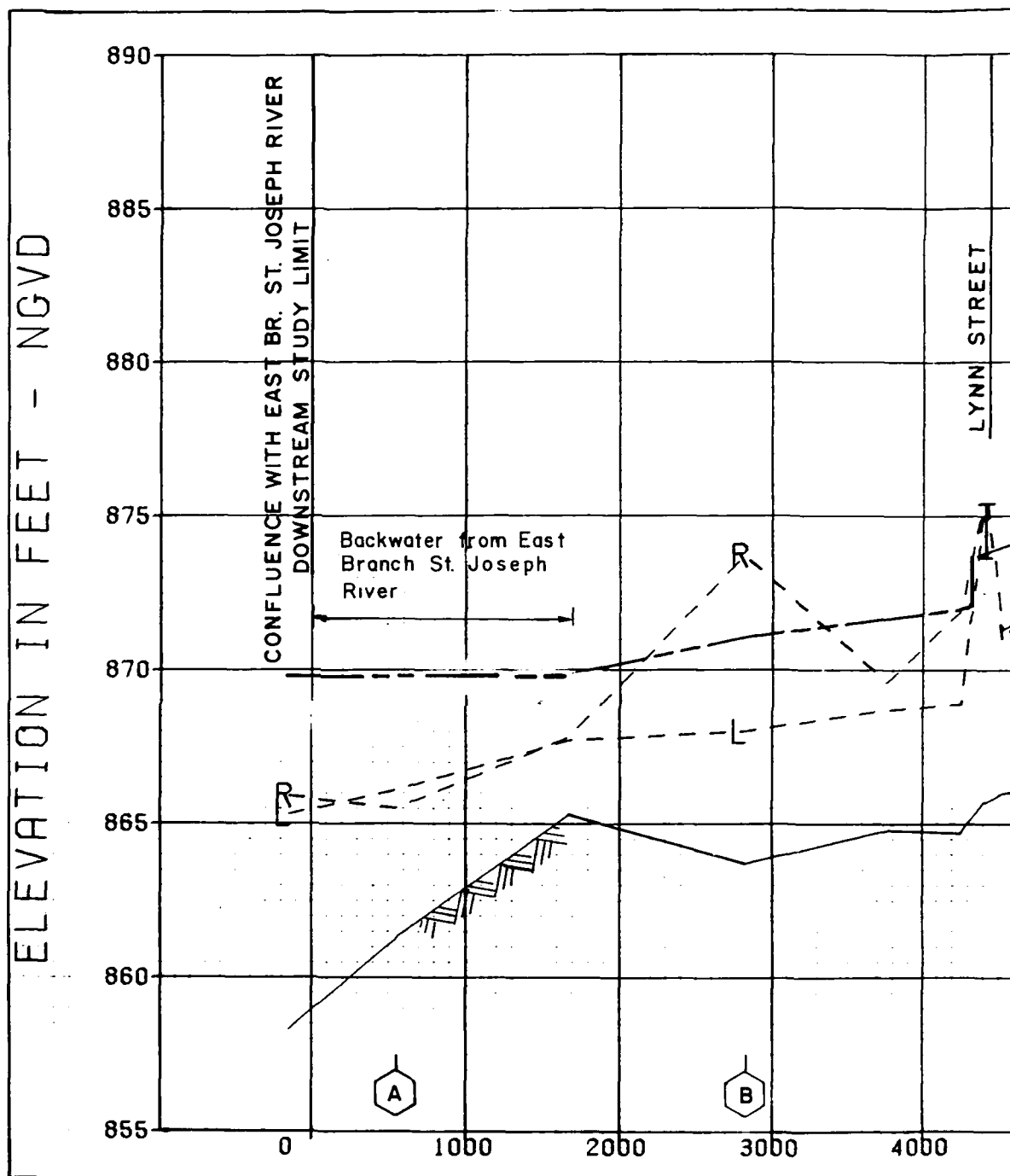
BACKWATER	The resulting high water surface in a given stream due to a downstream obstruction or high stages in an intersecting stream.
BASE FLOOD	A flood which has an average return interval in the order of once in 100 years, although the flood may occur in any year. It is based on statistical analysis of streamflow records available for the watershed and analysis of rainfall and runoff characteristics in the general region of the watershed. It is commonly referred to as the "100-year flood."
DISCHARGE	The quantity of flow in a stream at any given time, usually measured in cubic feet per second (cfs).
FLOOD	<p>An overflow of lands not normally covered by water. Floods have two essential characteristics: The inundation of land is temporary and the lands are adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water.</p> <p>Normally a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, and rise of groundwater coincident with increased streamflow.</p>
FLOOD CREST	The maximum stage or elevation reached by floodwaters at a given location.
FLOOD FREQUENCY	A statistical expression of the percent chance of exceeding a discharge of a given magnitude in any given year. For example, a <u>100-year flood</u> has a magnitude expected to be exceeded on the average of once every hundred years. Such a <u>flood</u> has a 1 percent chance of being exceeded in any given year. Often used interchangeably with <u>RECURRENCE INTERVAL</u> .
FLOOD PLAIN	The areas adjoining a river, stream, watercourse, ocean, lake, or other body of standing water that have been or may be covered by floodwater.

FLOOD PROFILE	A graph showing the relationship of water surface elevation to location; the latter generally expressed as distance upstream from a known point along the approximate centerline of a stream of water that flows in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.
FLOOD STAGE	The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.
FLOODWAY	The channel of a watercourse and those portions of the adjoining flood plain required to provide for the passage of the selected flood (normally the 100-year flood) with an insignificant increase in the flood levels above that of natural conditions. As used in the National Flood Insurance Program, floodways must be large enough to pass the 100-year flood without causing an increase in elevation of more than a specified amount (1 foot in most areas).
RECURRENCE INTERVAL	A statistical expression of the average time between floods exceeding a given magnitude (see FLOOD FREQUENCY).

#### REFERENCES

1. U.S. Department of Commerce, Bureau of the Census, 1980 Census of Population, Number of Inhabitants, Ohio, Washington, DC, February 1982.
2. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Climates of the States, Washington, DC, 1980.
3. Federal Emergency Management Agency, Flood Insurance Rate Map, Village of Pioneer, Williams County, Ohio, September 1988.
4. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-1 Flood Hydrograph Package, Davis, California, revised January 1985.
5. U.S. Geological Survey, 7.5 Minute Series Topographic Maps, Scale 1:24000, Contour Interval 10 feet: Pioneer, Ohio-Michigan, 1961, photorevised 1973.
6. Ohio Department of Natural Resources, Division of Water, Bulletin 45, Floods in Ohio, Magnitude and Frequency, E.E. Webber and W.P. Bartlett, Columbus, Ohio, May 1977.
7. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles Generalized Computer Program, Davis, California, 1974.



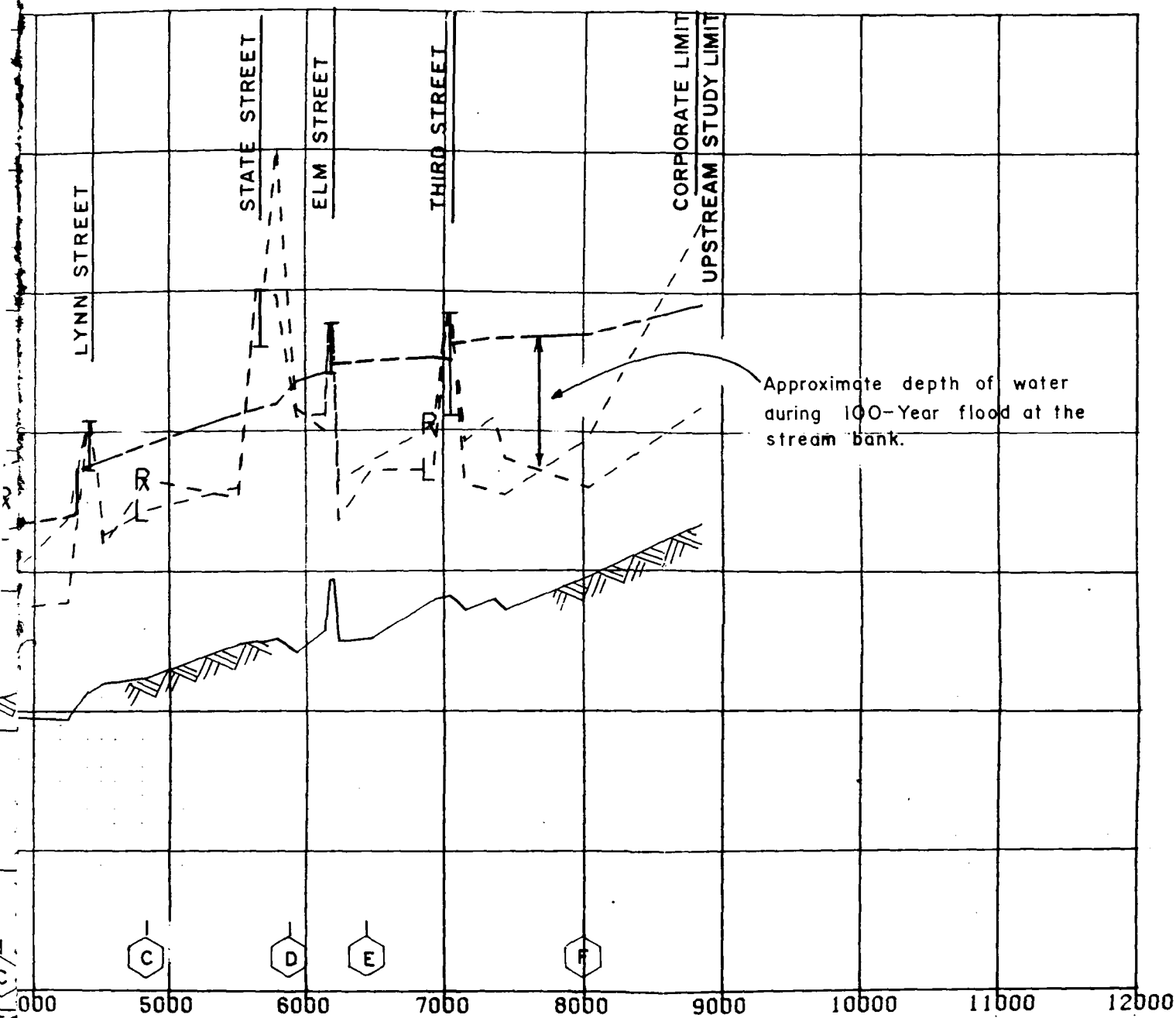


# LEGEND

- 100-YEAR FLOOD
- ▨ CHANNEL BOTTOM
- ⬡ CROSS SECTION LOCATION
- ⊥ BRIDGE
- R---R--- RIGHT TOP OF BANK
- L---L--- LEFT TOP OF BANK

NOTE: DISTA  
CONF  
JOSE

10F-2



DISTANCE IS MEASURED IN FEET FROM  
CONFLUENCE WITH EAST BRANCH ST.  
JOSEPH RIVER.

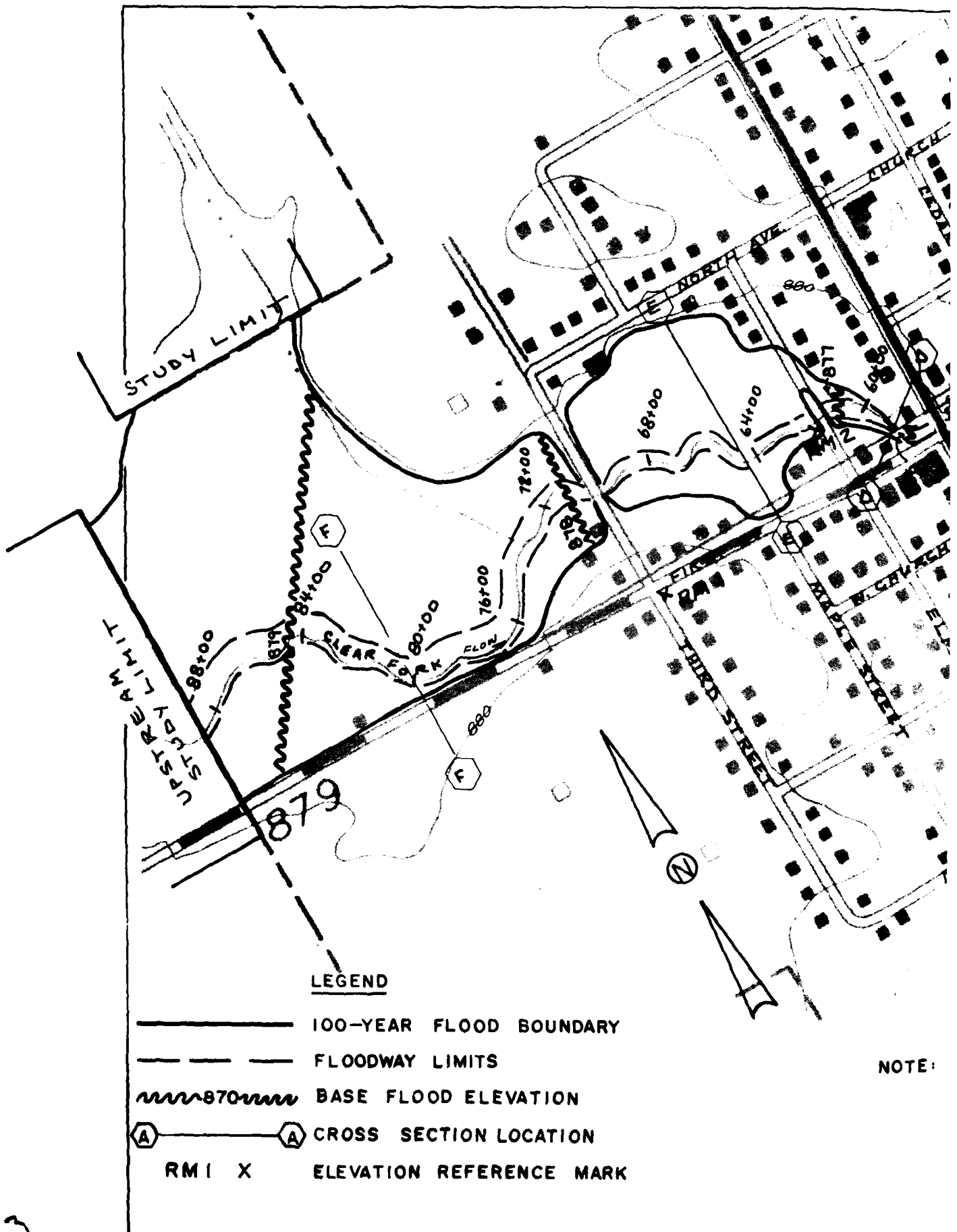
U. S. Army Engineer District, Buffalo  
SPECIAL FLOOD HAZARD EVALUATION

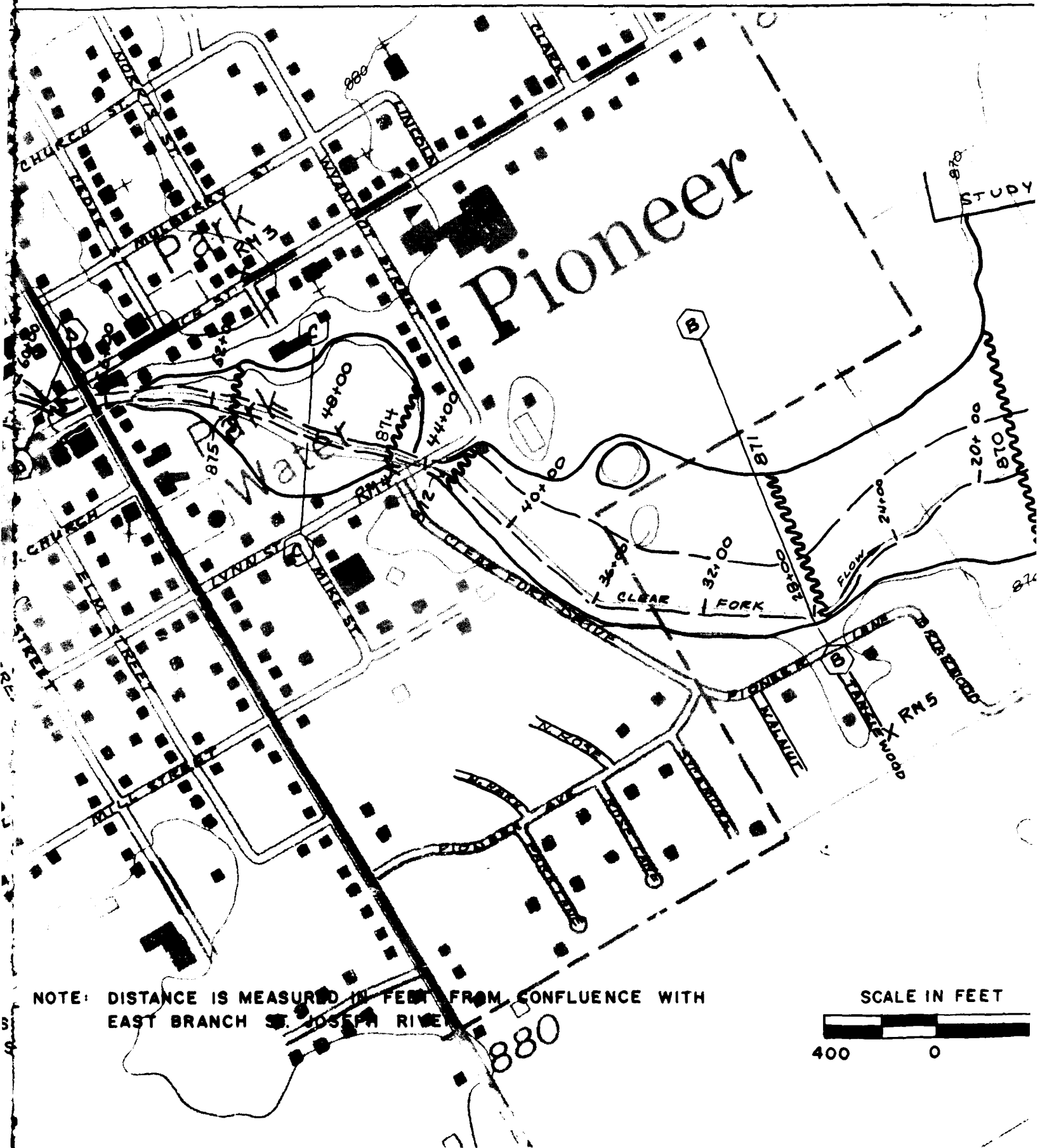
FLOOD PROFILE  
CLEAR FORK  
PIONEER, OHIO

20F2

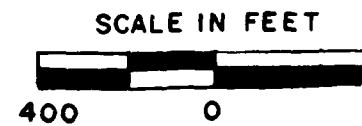
PLATE 1

SEPTEMBER 1989





NOTE: DISTANCE IS MEASURED IN FEET FROM CONFLUENCE WITH  
EAST BRANCH ST. JOSEPH RIVER



20F3

30F3

